Arizona Climate Change Advisory Group
Draft Pending Policy Option Descriptions
For the June 5, 2006 CCAG Teleconference Meeting

Tables and Policy Descriptions Attached:

Table #	**Technical Work Group**
Table 3	Energy Supply Pending Options List
Table 4	Energy Supply Options Descriptions
Table 5	Residential, Commercial and Industrial Pending Options List
Table 6	Residential, Commercial and Industrial Options Descriptions
Table 7	Transportation and Land Use Pending Options List
Table 8	Transportation and Land Use Options Descriptions
Table 9	Agriculture and Forestry Pending Options List
Table 10	Agriculture and Forestry Options Descriptions
Table 11	Cross Cutting Issues Pending Options List
Table 12	Cross Cutting Issues Options Descriptions

Table 3.

Energy Supply Technical Work Group

Summary List of Pending Policy Options

#	Policy Name	GHG Savings ($MMtCO_2e$)	Cost Effectiveness ($/$tCO_2e$)
	RENEWABLE AND LOW-EMITTING ENERGY		
ES-1	Environmental Portfolio Standard / Renewable Energy Standard and Tariff	1a(1) 2010: 1.39 2020: 8.0	$8
		1c 2010: 4.19 2020: 16.4	$6
ES-2	Public Benefit Charge Funds (4 mills; 3 to RCI, 1 to ES)	2010: 1.46 2020: 4.1	$280
	EMISSIONS POLICIES		
ES-5	Generation Performance Standards	2010: 5.63 2020: 10.2	$29
ES-6	Carbon Intensity Targets	2010: 0.0 2020: 14.0	$44
ES-8	CO2 Tax	2010: 0.53 2020: 2.4	$3
	GRID AND UTILITY POLICIES		
	No policy options remain pending from this section		

Table 4.

Description of Draft Energy Supply Policy Options

RENEWABLE AND LOW-EMITTING ENERGY

ES-1 Environmental Portfolio Standard / Renewable Energy Standard and Tariff (REST)

Policy Description:

An environmental portfolio standard (EPS) is a requirement that utilities must supply a certain percentage of electricity from environmentally friendly sources. An EPS differs from a Renewable Portfolio Standard (RPS) in that an EPS can include more options than renewables for meeting the requirement. Utilities can meet their requirements by purchasing or generating environmentally friendly electricity or by purchasing clean energy credits. By giving utilities the flexibility to purchase clean energy credits, a market in these credits will emerge that will provide an incentive to companies that are best able to generate clean energy, either through energy efficiency or renewables. Other options for meeting the requirement are possible depending on how the EPS is structured. For example, a provision can be included so that funding for research and development is applied toward meeting a utility's commitment.

Policy Design:

ES-1a(0): The likely changes by the Arizona Corporations Commission (ACC) to the EPS applied only to ACC-jurisdictional utilities: 5% in 2015, 15% in 2025; Starting in 2007, 5% of the total renewable requirement must be from distributed renewables, increasing to 30% by 2011 and remaining at 30% in future years. Renewable Energy Credit (REC) trading is allowed, provided that all other associated attributes are retired when applying RECs to the Annual Renewable Energy Requirement; out-of-state resources can be used provided that the necessary transmission rights are obtained and utilized.

ES-1a(1): **The ACC's likely changes to the EPS, with SRP continuing with its proposed renewable investments**. The SRP has set a target to generate 15% of its electricity from renewable resources by 2025.

ES-1a(2): The ACC's likely changes to the EPS extended statewide.

ES-1b: Alternative scenario for ACC jurisdictional utilities: 1% in 2005, increasing 1% each year to 26% in 2025. Allow out-of-state renewables and REC trading.

ES-1c: Alternative scenario extended statewide.

- **Goal levels:** As noted above.
- **Timing:** As noted above.
- **Parties:** Utilities as noted above.
- **Other:** Apply a least-cost approach, reflecting resource availability constraints, to determine which renewable energy resources and technologies would be used to meet the EPS beyond the specific requirements laid out in the proposals.

Implementation method(s): An EPS is usually implemented through a regulatory requirement (mandate) on the applicable utilities.

Related Policies/Programs in place:

In the existing EPS, utilities (not including SRP) must generate a specified percentage of their total retail sales from renewable energy:

- Started in 2001 at 0.2% and increased annually to 1% in 2005 and will increase to 1.1% in 2007. Expires in 2012.
- 2001–2003: 50% of current EPS requirement must be solar electric; remainder can be other environmentally friendly technologies including no more than 10% R&D.
- 2004–2012: 60% of resources must be solar electric.
- Environmental Portfolio Surcharge of $0.000875 per kWh with caps by customer class.

Type(s) of GHG Benefit(s):

- CO2: By creating a substantial market in renewable generation, an EPS can reduce fossil fuel use in power generation, and correspondingly reducing CO2 emissions
- Black Carbon: To the extent that generation from coal and oil is displaced by renewables, black carbon emissions will decrease.

Estimated GHG Savings and Costs Per Ton:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-1	RE/Std/Tariff, ES-1a(0)	ACC Proposal alone	0.80	4.4	26	331	13
ES-1	RE/Std/Tariff, ES-1a(1)	ACC Proposal + SRP program	1.39	8.0	47	366	8

ES-1	RE/Std/Tariff, ES-1a(2)	ACC Proposal Statewide	1.42	7.7	46	538	12
ES-1	RE/Std/Tariff, ES-1b	Alternative Proposal for ACC Utilities	2.31	9.2	65	281	4
ES-1	RE/Std/Tariff, ES-1c	Alternative Proposal Statewide	4.19	16.4	116	752	6

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sargent & Lundy.
- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. A trajectory of MWhs needed to satisfy the Renewable Energy Standard and Tariff (REST) requirement was calculated, both for central renewable generation and distributed renewables. Renewable and fossil technologies were characterized in terms of cost and operating profiles, and available resources in the state were also defined. Technologies include three classes of wind, concentrating solar power, geothermal, biomass, landfill gas, distributed solar PV, distributed solar thermal, conventional coal, integrated gasification combined cycle with carbon capture and storage (IGCC with CCS), natural gas combined cycle (NGCC), and natural gas combustion turbines (NGCT). We assumed that 75% of the REST requirement would be met through REC trading. We also assumed that corresponding CO2 reductions would be bundled with the RECs and count toward the emission reduction performance of this policy. We assumed a $5 per MWh REC price, which is consistent with available low-cost wind and other renewable resources in the West and is consistent with REC price assumptions in Integrated Resource Plans by various western utilities as reported in *Balancing Cost and Risk: The Treatment of Renewable Energy in Western Utility Resource Plans* (August 2005, Lawrence Berkeley National Laboratory). The model found the least-cost mix of renewables, constrained by available resources, to satisfy 25% of the central renewable requirement. An assumption that the distributed renewable requirement will be met by 50% solar PV and 50% solar thermal was made. Each renewable was also defined by the share of generation it displaces from NGCT, NGCC, and coal. The model then determines how many MWhs of NGCT, NGCC and coal would be displaced and the corresponding CO2 emissions. The model also tracks the cost of generation for renewables and the displaced fossil; the present value of the difference is reported above.

- **Key Assumptions:** Cost and performance characteristics of generating technologies; resource availability; no demand response as a result of policy; no transmission and distribution modeled.

Key Uncertainties:

As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- Reductions in overall energy consumption and the shift from fossil fuel generation as a result of an EPS will lead to reductions in criteria air pollutants and, consequently, lower health impacts and costs associated with those pollutants.
- Water use may be reduced through renewable versus combustion technologies.
- While much of the EPS requirement will come from low-cost renewables such as wind and biomass, meeting the requirement may lead to a moderate increase in direct costs to utilities implementing the EPS policy and a small increase in overall electricity system cost for Arizona. At the same time, investment in new technologies resulting from the EPS may spur economic development and corresponding job growth, and to the extent the renewable energy is derived from Arizona-based capital projects, additional local tax revenues will also be generated.

Feasibility Issues, if applicable:

Status of Group Approval: (Pending or Completed)

[The TWG has forwarded to the CCAG two of the five options that it considered, Option ES-1a(1) and ES-1c. The former represents essentially a new "base case" since the CCAG process began, as it reflects changes that the ACC is about to adopt as well as SRP's renewable energy commitment. The latter sets substantially more aggressive targets, and yields somewhat better cost effectiveness.]

Level of Group Support: (Unanimous Consent, Supermajority, Majority, or Minority)

Barriers to consensus (if less than unanimous consent):

ES-2 Public Benefit Charge Funds

Policy Description:

A public benefit fund (PBF) is a state fund dedicated to support energy efficiency (EE) and renewable energy (RE), funded through a per kilowatt-hour charge on electricity sales. To date, nineteen states have implemented PBF programs. A small charge rate, typically in the 2 to 5 mils per kWh range, is applied to electricity sales in the state and collected by a PBF manager. Funds are typically used to support EE and RE in a number of ways, such as through public education, R&D, demonstration projects, direct grants/buy-downs/tax credits to subsidize advanced technologies, and low interest revolving loans. Funding goes to the residential, commercial and industrial sectors. Fund managers decide which technologies to support based on criteria such as GHG reduction potential, cost-effectiveness, co-benefits, etc.

Policy Design:

Introduce a 4 mils ($0.004) per kWh charge to be applied as determined by an authorized entity, probably the ACC. For the purposes of analysis, we assume that 1 mil per kWh is available for distributed renewable generation; the remaining portion of the fund is applied to energy efficiency projects and is quantified by the RCI TWG. We assume that 50% of renewable funding supports solar photovoltaics and 50% supports solar thermal technologies. The sum raised for distributed renewables would be approximately $100-145 million per year.

- **Goal levels:** As noted above.
- **Timing:** ASAP.
- **Parties:** Public Benefit Fund Manager created by legislature. Utilities will collect the charges from customers and transfer to the Fund Manager. Fund Manager will distribute money to be implemented at the residential, commercial and industrial levels.
- Other:

Implementation method(s):

- Funding mechanisms and or incentives
- Pilots and demos
- Research and development
- Education

Related Policies/Programs in place: There is no PBF in place in Arizona.

Type(s) of GHG Benefit(s):

- CO_2: By spurring investment in energy efficient technologies and small-scale renewable generators, PBF programs reduce the need for generation from fossil fuel plants, which can lead to a significant reduction in GHG emissions.
- Black Carbon: To the extent that generation from coal and oil is displaced by energy efficiency and renewables, black carbon emissions will decrease.

Estimated GHG Savings and Costs Per Ton:

			Reductions (MMTCO2e)		

#	Policy	Scenario	2010	2020	Cumulative Reductions (2006 - 2020)	NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
ES-2	Public Benefits Fund	(Distributed Renewables only)	1.46	4.1	34	9383	280

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sargent & Lundy.
- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. This policy was partly analyzed by the RCI TWG. We assumed that 1 mil per kwh of the 4 mils charge in this policy would be devoted to distributed renewable generation. The 1 mil per kwh charge was applied to the reference case forecast of electricity generation to determine the total annual funding available. We assumed that half of the funding would go toward PV and half toward solar thermal. The funding would cover the difference between the cost of distributed renewables and the retail cost of electricity, reflecting the incremental funding needed to achieve the investment. Renewable and fossil technologies were characterized in terms of cost and operating profiles, and available resources in the state were also defined. The model calculated the PV and solar thermal generation resulting from the PBF funding. Each distributed renewable was also defined by the share of generation it displaces from NGCT, NGCC, and coal. The model then determines how many MWhs of NGCT, NGCC and coal would be displaced and the corresponding CO2 emission reductions. The model also tracks the cost of generation for renewables and the displaced fossil; the present value of the difference is reported above.
- **Key Assumptions:** Cost and performance characteristics of generating technologies now and in the future; resource availability; no demand response as a result of policy; no transmission and distribution modeled.

Key Uncertainties:

- As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- Reductions in overall energy consumption and the shift from fossil fuel generation as a result of a PBF will lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.
- Water use may be reduced through renewable versus combustion technologies.
- Much of the investment made by the PBF will go into zero- or low-cost (even negative-cost) energy efficiency and small-scale renewables, and the PBF program can more than pay for itself through cost-effective investments. Nevertheless, the impact on the larger electricity system of the PBF program can lead to a small increase in overall electricity system cost. At the same time, though, investment in new technologies resulting from the PBF could spur economic development in Arizona.

Feasibility Issues, if applicable:

Status of Group Approval: (Pending or Completed)

[The TWG did not reach a consensus recommendation to forward this policy option to the CCAG due to its high cost-per-ton reduced.]

Level of Group Support: (Unanimous Consent, Supermajority, Majority, or Minority)

Barriers to consensus (if less than unanimous consent):

ES-5 Generation Performance Standards

Policy Description:

A generation performance standard (GPS) is typically a requirement that electricity utilities or load serving entities (LSE) sell electricity with an average emission rate below a specified mandatory standard. Utilities must take action to ensure that their generation mix meets the standard.

A variation of a GPS is to incorporate the standard within a cap and trade system in which permits are allocated by dividing the total cap by the total number of MWhs generated to arrive at the performance standard. Permits are then given to each participant based on its own generation multiplied by the performance standard. Generators with emission rates lower than the GPS would receive more allowances than they need. Generators with emission rates higher than the GPS would receive fewer allowances than needed. As electricity generation increases, everything else being equal, the number of permits per MWh would decline because of the cap.

A third variation of a GPS is to establish the standard and allocate allowances based on that standard every year. In this variation, as electricity generation increases, plants would receive more permits. Utilities could trade permits in order to achieve the standard, but there would be no fixed cap on emissions. This variation provides a financial incentive (via trading) for generators to reduce emissions so that they can sell unneeded permits to generators who have high emissions.

Policy Design:

Apply a GPS only to new generation. As new capacity comes on-line, those plants would receive an allocation based on the GPS standard. Utilities could trade permits in order to achieve the standard, but there would be no fixed cap on emissions. The GPS level would be equivalent to a new natural gas combined cycle plant. Assessment of this option should consider that new electricity demand in Arizona might be served, at least in part, by out-of-state resources. Accordingly, analysis of this option should consider how a GPS policy might affect decisions to build new capacity inside or outside of Arizona.

- **Goal levels:** Set a GPS equivalent to a new natural gas combined cycle plant applicable to new supply whether generation or imported power.
- **Timing:** As new generation capacity is built or power is imported.
- **Parties:** Utilities (electricity generators).
- Other:

Implementation method(s):

- Market based mechanisms with underlying regulatory obligation.

Related Policies/Programs in place:

- No GPS system is in place in Arizona.

Type(s) of GHG Benefit(s):

- CO_2: A cap & trade system is a direct limit on CO_2 emissions. Reductions are determined by the level of the cap.
- Black Carbon: To the extent that generation from coal and oil declines under a cap and trade system, black carbon emissions will also decrease.

Estimated GHG Savings and Costs Per Ton:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-5	Generation Performance Standard	All new supply (generated or imported) as clean as NGCC	5.63	10.2	104	2980	29

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sargent & Lundy.

- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. Renewable and fossil technologies were characterized in terms of cost and operating profiles, and available resources in the state were also defined. Technologies include three classes of wind, concentrating solar power, geothermal, biomass, landfill gas, conventional coal, integrated gasification combined cycle with carbon capture and storage (IGCC with CCS), natural gas combined cycle (NGCC), and natural gas combustion turbines (NGCT). The reference case forecast of electricity generation was the starting point for this analysis. We assumed that existing resources would continue to operate in the state over the analysis period. We subtracted generation from existing resources from the reference forecast of total generation to find a new generation forecast. The model then found the least-cost mix of new generation needed, subject to the constraint that all new generation must have an equal or lower emission rate than new natural gas combined cycle plants. The model tracks cost and CO2 emissions associated with new generation. We also ran the model without constraints to develop a reference case. We then calculate the difference in CO2 emissions and total cost of generation between the policy case and the reference case. Those results are reported above.
- **Key Assumptions:** Cost and performance characteristics of generating technologies now and in the future; resource availability; no demand response as a result of policy; no transmission and distribution modeled.

Key Uncertainties: As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- The shift from fossil fuel generation as a result of a GPS system will lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.

Feasibility Issues, if applicable:

Status of Group Approval:

[The TWG's consensus recommendation was to forward this policy option to the CCAG as it produced substantial GHG reductions at a moderate cost-per-ton reduced.]

Level of Group Support:

Barriers to consensus (if less than unanimous consent):

ES-6 Carbon Intensity Targets

Policy Description:

Rather than a fixed cap on carbon emissions, a carbon intensity target is a limit on the ratio of carbon emissions to a measure of output. Absolute emissions can increase as output increases. Measures of output are clear for some sectors like electricity generation (e.g., MWh), but can difficult for other sectors (e.g., manufacturing). One measure of output for other sectors could be dollars equal to the value of the output.

Policy Design:

Arizona implements a mandatory carbon intensity target that begins in 2010 (equal to carbon intensity in 2010) and that declines by 3% annually through 2025. The carbon intensity target is translated annually into a cap, and trading is allowed under that cap.

- **Goal levels:** As noted above.
- **Timing:** As noted above.
- **Parties:** Utilities and electric generators.
- **Other:**

Implementation method(s):

- Market based mechanisms with underlying regulatory obligation.

Related Policies/Programs in place:

- No carbon intensity target is in place in Arizona.

Type(s) of GHG Benefit(s):

- CO2: A carbon intensity target may or may not reduce CO2 emissions. A stringent intensity target is more likely to lead to reductions than a lenient target. A less stringent target may curb growth in emissions, but not reduce absolute emissions.
- Black Carbon: To the extent that generation from coal and oil declines under a carbon intensity target, black carbon emissions will also decrease.

Estimated GHG Savings and Costs Per Ton:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-6	Carbon Intensity Target	Intensity improvement of 3%/year 2010-2025	0.00	14.0	70	3119	44

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sargent & Lundy.
- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. Renewable and fossil technologies were characterized in terms of cost and operating profiles, and available resources in the state were also defined. Technologies include three classes of wind, concentrating solar power, geothermal, biomass, landfill gas, conventional coal, integrated gasification combined cycle with carbon capture and storage (IGCC with CCS), natural gas combined cycle (NGCC), and natural gas combustion turbines (NGCT). The reference case forecast of electricity generation was the starting point for this analysis. We assumed that existing resources would continue to operate in the state over the analysis period. We subtracted generation from existing resources from the reference forecast of total generation to find a new generation forecast. The model then found the least-cost mix of new generation needed, subject to the constraint that CO2 emissions not exceed the limit imposed by the carbon intensity target. The model tracks cost and CO2 emissions associated with new generation. We also ran the model without constraints to develop a reference case. We then calculate the difference in CO2 emissions and total cost of generation between the policy case and the reference case. Those results are reported above.
- **Key Assumptions:** Cost and performance characteristics of generating technologies now and in the future; resource availability; no demand response as a result of policy; no transmission and distribution modeled.

Key Uncertainties:

- As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- The shift from fossil fuel generation as a result of a carbon intensity target will lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

[The TWG did not reach a consensus recommendation to forward this policy option to the CCAG due to remaining uncertainty as to how it would be achieved and how broadly it applied.]

Barriers to consensus (if less than unanimous consent):

ES-8 CO2 Tax

Policy Description:

A CO2 tax is a tax on every ton of CO2 emitted. Companies would either pass the cost on to consumers, change production to lower emissions, or a combination of the two. Either way, consumers would see the implicit cost of CO2 emissions in products and services and would adjust behavior to purchase substitute goods and services that result in lower CO2 emissions. Typically, a CO2 tax is put in place with an income tax reduction to offset the economic impact of the new tax. CO2 tax revenue could go completely to income tax reductions or part of it could go toward policies and programs to assist with CO2 reductions.

Policy Design:

Adopt a flat $5 per ton economy-wide, upstream CO2 tax, analyzing this tax as if adopted on a national basis and evaluating the resulting impact on Arizona. Other levels (such as $10/ton and $15/ton) may be assessed if resources permit so as to consider elasticity in costs and GHG reductions. Some members of the CCAG expressed concern about moving forward with analyzing this option.

- **Goal levels:** As noted above.
- **Timing:**
- **Parties:** All (economy-wide).
- Other:

Implementation method(s):

- Market-based (economic) mechanism with underlying legal obligation.

Related Policies/Programs in place:

- No CO2 tax is in place in Arizona.

Type(s) of GHG Benefit(s):

- CO2: A CO2 tax is a disincentive to emit CO2 emissions. Producers and consumers will adjust behavior to avoid the tax and thereby reduce CO2 emissions in the process.
- Black Carbon: To the extent that generation from coal and oil declines under a CO2 tax, black carbon emissions will also decrease.

Estimated GHG Savings and Costs Per Ton:

#	Policy	Scenario	Reductions (MMTCO2e) 2010	2020	Cumulative Reductions (2006 - 2020)	NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
ES-8	CO2 Tax	$5/ton upstream tax, results are for electricity only	0.53	2.4	11	30	3

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** Data for the electricity modeling done in this analysis comes from the US Energy Information Administration (EIA) and can be found within the National Energy Modeling System (NEMS). Data in NEMS includes representation of the existing generation, transmission and distribution system down to the unit level. NEMS also includes data that characterizes new plants that the model can choose to build to meet projected demand growth. EIA publishes Assumptions to the Annual Energy Outlook that details key assumptions in the current version of the model. EIA also publishes NEMS model documentation.
- **Quantification Methods:** We applied a tax of $5 per ton CO2 to electricity generators at the national level. CO2 reductions were found by comparing emissions from the policy case to emissions from a reference case. Costs were estimated by comparing policy and reference case new generating capacity investments, operating and maintenance costs for all generation, fuel costs for all generation, and transmission and distribution costs for all generation. The reported cost for the policy is the net present value of the difference in the above costs between the policy and reference cases. Because the NEMS model captures the CO2 tax in the price of fuel, we simply substituted the reference case price of fuel for the policy case price of fuel, which reflects the CO2 tax. In treating CO2 tax revenues in this way, we implicitly assumed that the revenues would be recycled back to Arizona. However, we did not distinguish how the revenue would be recycled, nor did we capture any macroeconomic effects of recycling. The costs reported are the direct social cost of the policy (not accounting for macroeconomic impacts), not the cost to utilities and ratepayers, which depends on whether and how revenues are recycled. Because the NEMS model is a national model with multi-state regions (Arizona is within the Rocky Mountain Power Area), the results for Arizona were derived from results in the region. We shared out the regional emission and cost results according to the share of Arizona generation within the region.

- **Key Assumptions:** Any analysis of state-level policies using the National Energy Modeling System (NEMS) from the US Energy Information Administration should be weighed carefully. NEMS is a national model that consists of 13 regions. State policies cannot be implemented explicitly within NEMS, and the state-specific impacts cannot be known explicitly. We must make assumptions about the impact of policies at the state level by sharing out regional results. In reality, the state-level changes resulting from policy may differ substantially from the changes in the region.

Key Uncertainties:

As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are related directly to the key assumptions and quantification methods listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- The shift from fossil fuel generation that would result from a CO2 tax would lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.
- Shifting from an income tax to a CO2 tax could have economic benefits by encouraging productive activity and discouraging harmful emissions.

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

[The TWG's consensus recommendation was to forward this policy option to the CCAG for its consideration. The TWG requested sensitivity analyses at $10 and $15 per ton. At $15, cumulative GHG reductions are nearly triple (28 MMTCO2e) at costs of -$2 per ton. Initial indications regarding $10 are counter-intuitive, yielding only marginally better reductions than $5 at substantially greater costs.]

Barriers to consensus (if less than unanimous consent):

GRID AND UTILITY POLICIES

No policy options remain pending in this category.

Table 5.

Residential Commercial and Industrial Technical Work Group

Summary List of Draft Policy Options

#	Policy Name	GHG Savings ($MMtCO_2e$)	Cost-Effectiveness ($/$tCO_2e$)
	RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL		
RCI-12	Solid Waste, Wastewater, and Water Use Management		

Table 6.

Description of Draft Transportation and Land Use Policy Options

RCI-12 Solid Waste, Wastewater, and Water Use Management

Option Category: Quantified or Not Quantified (TBD)

Description: Policies to reduce solid waste production and related landfill methane emissions through recycling and composting, as well as policies to reduce greenhouse gas emissions related to wastewater and water use management, have not yet been considered in any detail by the RCI TWG. ***Efforts are underway to work with experts in these areas to elaborate these policies—see below.***

Design: Possible actions to reduce GHG emissions from waste and wastewater management could include:

- Increase average statewide waste wood and mixed paper recovery rates to xx% by 20xx.
- Increase average statewide paper, plastic, metals and other materials recovery rates to xx% by 20xx.
- Implement food and yard waste composting.
- Capture and use (potentially displacing fossil fuel use) and/or flare methane at small non-NSPS landfill sites.
- Implement programs to reduce the consumption of packaging materials.

Note that a conference call with Solid Waste experts was held May 10, and additional input is expected shortly from the Solid Waste working group.

Possible actions to reduce GHG emissions through water use management

include:

- Reductions in electricity needs for water pumping due to from reduced water demands by RCI users and other sectors such as agriculture and electricity generation, or due to improved water management. (Note that to the extent ground water pumping as well as surface water delivery is due to agricultural demands, the AF TWG may best address this option.)
- Recover and use (potentially displacing fossil fuel use) methane from wastewater processing activities

CCAG members suggested that these are high priority options deserving of additional attention and the involvement of those with expertise in the waste-management and other areas[1]. Options covered under RCI-12 need to be separated into logical categories and further refined.

A call is scheduled for June 7th with SRP and SWEEP to develop water use reduction options further. It remains to be decided whether water use options should be covered under a separate policy option (for example, RCI-13 or possibly under the Cross Cutting TWG) as there is little overlap between water use and solid waste options.

Implementation method(s):

Related Policies/Programs in place:

[1] *CCAG members noted that there are a mix of different jurisdictions covered by this option, and that possible contributors to elaborating these options could include solid waste experts from the Department of Environmental Quality, operators of private landfills that receive wood wastes, and others.*

Types(s) of GHG Benefit(s): Various activities could reduce in methane emissions from landfills or wastewater treatment. CO_2 emissions would be reduced from avoided fossil-fueled electricity production (due, for example, to pumping electricity savings) or on-site fuel displacement. Some small reduction in methane emissions could result from avoided fuel combustion in electricity generation and avoided natural gas pipeline leakage due to fuel displacement (modest impact).

N_2O emissions might decline as the result of changes wastewater treatment methods. Other GHGs are unlikely to be significantly affected.

Estimated GHG Savings and Costs per Ton (for quantified actions):

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:**
- **Quantification Methods:**
- **Key Assumptions:**

Key Uncertainties:

Ancillary Benefits and Costs: These could include:

- Reduced cost of electricity for water pumping, displaced fuels costs for users of landfill gas and captured gas from waste treatment facilities.
- Central-station powerplant cooling water savings
- Potential local air quality impacts (may be positive or negative, depending on technology)
- Reducing dependence on imported fuel sources, and reducing vulnerability to energy price spikes
- Reduction in disposal cost, reduction in environmental impacts related to disposal of wastes that are recycled and/or composted
- Sales of soil amendments from composted materials (and increased soil fertility from use of materials)
- Income from sales of recycled materials
- Reduction of impacts related to manufacturing of new materials through recycling
- Potential electricity (grid) system benefits: reduced peak demand, reduced capital and operating costs, improved utilization and performance of the electricity system, reduced pollutant emissions from power plants and related public health improvements
- Supporting local businesses (related to recycling, composting) and stimulating

economic development

Feasibility Issues, if applicable:

Status of Group Approval: (Pending or Completed)

Level of Group Support: (Unanimous Consent, Supermajority, Majority, or Minority)

Barriers to consensus (if less than unanimous consent):

Table 7.

Transportation and Land Use Technical Work Group

Summary List of New Draft Policy Options

#	Policy Name	GHG Savings (MMtCO2e)	Cost-Effectiveness ($/tCO2e)
TLU-4	Reduction of Vehicle Idling *(revised to add stronger implementation option)*	*Scenario 1* 2010: 0.3-0.5 2020: 0.5-0.7 *Scenario 2* 2010: 0.5-0.7 2020: 0.7-1.0	TBD
TLU-7	Hybrid Promotion and Incentives	In progress – unlikely to achieve much beyond TLU-1 (California car standards)	
TLU-8	Feebates	negligible GHG impacts beyond TLU-1 (California car standards)	
TLU-9	Pay-As-You-Drive Insurance	2010: n/a	TBD

		2020: 2.8	
TLU-10	Low Rolling Resistance Tires	2010: n/a 2020: 0.7	TBD
TLU-11	Diesel Engine Retrofit	2010: 0.1-0.3 2020: ~0.01	TBD
TLU-12	Biodiesel Implementation	2010: 0.1-0.2 2020: 1.1-2.2	TBD

Table 8.

Description of Draft Transportation and Land Use Policy Options

TLU-4 Reduction of Vehicle Idling

Option Category: Quantified

Policy Description: Reduce idling from diesel and gasoline heavy-duty vehicles, buses, and other vehicles through the combination of a Statewide anti-idling ordinance and by promoting and expanding the use of technologies that reduce heavy-duty vehicle idling, including: automatic engine shut down/start up system controls; direct fired heaters (for providing heat only); auxiliary power units; and truck stop electrification.

Policy Design: Currently, only Maricopa County has an anti-idling ordinance. This ordinance has not been enforced due to a lack of enforcement funding and enforcement authority. This policy would build off of the Maricopa County ordinance, strengthen it, and make it applicable statewide by the end of 2008. The statewide ordinance should be designed to be easily enforceable by the appropriate state and local agencies, and should have a dedicated state funding stream for enforcement. The ordinance would also need to limit exemptions as much as possible, to make it easier to enforce.

This measure will also reduce idling from heavy-duty vehicles through programs aimed at increasing voluntary adoption of idle reduction technologies. ADEQ and the county agencies would collaborate on outreach and education beginning in the year 2008, to coincide with the implementation and enforcement of a statewide anti-idling ordinance. The State would also seek funding for pilot projects and demonstrations from CMAQ (Congestion Mitigation Air Quality) funds, as well as funds available through EPA, DOE, and DOT. These pilot programs could be used to evaluate the effectiveness of various idle reduction technologies prior to more widespread use throughout the state. Pilot projects could include truck stop electrification as well as an expanded school bus pilot program. The outreach materials should emphasize the benefits of reducing idling, including a reduction in fuel costs, GHG emissions, and toxic emissions.

- **Goal levels:** Implement a statewide vehicle idling restriction ordinance that can be enforced and that minimizes allowable exemptions, and provide the necessary resources for enforcing the ordinance. Develop and pilot truck stop electrification programs. Scenario 1: Target an overall reduction in idling of 50% by year 2010. Scenario 2: Target an overall reduction in idling of 80% by 2010 and 100% by 2020.
- **Timing:** Have ordinance in place by 2008.
- **Parties:** Industry, ADEQ, Counties, school districts, truck stop owners

Implementation methods:

Information and education: Provide general public, trucking industry, and bus companies with information indicating when and where idling is prohibited, and under what circumstances it is permitted. Indicate the GHG and other benefits of reducing idling, including toxic emission reductions and fuel savings. Provide a hotline number to call to report violations. Encourage trucking companies to do their own policing of measure. Also reach out to busing companies, school districts, and truck stop owners to make bus and truck drivers aware of idling restrictions. Ensure that signs are also posted in venues associated with bus idling (e.g., sporting events, shows, etc.). Emphasize the fuel savings benefits, reductions in toxic emissions, and reduced engine wear associated with reducing idling

Provide information to fleet carriers, shippers, retailers, bus companies, school districts, and others involved in the diesel fleet industry indicating the economic benefits, as well as the environmental benefits, of applying idle reduction technologies. Also, identifying best practices within the industry and recognizing companies with these best practices in place within Arizona should be used to encourage companies to select these carriers for their shipments. Develop outreach materials with cost benefits information and toxic diesel health impacts. Outreach materials should also be geared toward making the general public aware of the GHG, toxics, and fuel-saving benefits of eliminating idling on personal vehicles, as well as on trucks and buses. Expand school bus idling program based upon the pilots currently being conducted.

Technical assistance: Coordinate with anti-idling product manufacturers to organize workshops/outreach programs to regulated community to let them know of technological options that provide alternatives to the need for idling including products for cabin comfort, power for other functions (e.g., refrigerated trucks), and engine warm-up.

Funding mechanisms and or incentives: Propose legislation to partially fund idling technology loan grants for truck stop electrification and other idle reduction technologies in the State, focusing grants on high idling areas. Determine a dedicated funding stream that can be used to fund enforcement of anti-idling ordinance as well as for continued education and outreach. Funding the enforcing agency with an adequate share of the revenue from using the idling reduction facilities could be an option. CMAQ funds and federal money may be available for idle reduction programs. A plan needs to be developed to apply for the funds.

Voluntary and or negotiated agreements: Work with regulated entities to promote voluntary compliance assistance through distribution of materials, staff training, etc. Encourage participation in EPA's SmartWay Transport Partnership (or similar programs).

Codes and standards: Include proper language in ordinance so that the agency with enforcement responsibilities is clearly delineated and has full authority to enforce the ordinance. The language of the statewide ordinance should also make enforcement straightforward (e.g., such that any exemptions to the idling policy can be easily observed).

Pilots and demos: Coordinate with product developers to help them promote their technologies. Investigate availability of funds for pilot or demo projects on idle reduction technologies from EPA, DOE, and DOT. If funding is available, develop a pilot program to evaluate the effectiveness of various idle reduction technologies, including implementation of truck stop electrification and expanded school bus idling program. Evaluate the effectiveness of the pilot programs before implementing on a broader scale.

Reporting: Develop a system for tracking violations so that the State can eventually determine compliance rates and benefits achieved from the ordinance.

Enforcement: Phase enforcement program to initially conduct outreach (Phase 1), provide warnings for a limited period of time (Phase 2), then issuance of tickets (Phase 3).

Related Policies/Programs in place:

Idling restrictions are currently in place in Maricopa County. House Bill 2538, (2001 regular session) requires counties containing portions of Area A to implement and enforce ordinances limiting maximum idling time for Heavy Duty Diesel Vehicles weighing over 14,000 pounds gross vehicle weight rating (GVWR). Other counties in Arizona also have the option of adopting an ordinance. The Maricopa County ordinance states "No owner or operator of a vehicle shall permit the engine of such vehicle to idle for more than five (5) consecutive minutes except as provided in Section 4 (Exemptions) of this ordinance." Violators are subject to a civil penalty of $100 for the first violation and $300 for a second or any subsequent violation, and can be enforced by any law enforcement officer on private/public property. Truck stop/distribution center owners/operators are required to erect signs indicating the maximum idling time in Maricopa County is 5 minutes. Exemptions are allowed under a number of conditions. To date, however, no violators of this ordinance have been fined. (Maricopa County Ordinance can be found at http://www.maricopa.gov/aq/rules/docs/fin-VIRO.pdf)

ADEQ School Bus Idling program. A number of school districts are participating with ADEQ in their School Bus Idling Pilot project. Key elements of this project include having drivers turn off buses upon reaching a school or other location and not turn on the engine until the vehicle is ready to depart; parking buses at least 100 feet from a school air intake system; and posting appropriate signage advising drivers to limit idling near the school. This program could be expanded throughout the state.

Idle reduction programs are currently being used by some shippers/carriers/retailers in Arizona. As an example, Swift Transportation is a charter member of EPA's SmartWay Transport program. This company maintains a modern fleet with an average vehicle age of less than 3 years old. Idle strategies used include optimized idle and other technologies as well as driver training.

Types(s) of GHG Benefit(s):

Reducing idling will reduce black carbon emissions, as well as all other GHG exhaust emissions (CO_2, CH_4, N_2O) through reduced fuel consumption. However, it is important to also ensure that any technologies used to reduce idling have lower emissions than the diesel truck idling emissions they are replacing.

Estimated GHG Savings and Costs Per Ton (for quantified actions):

	2010	2020	Units
GHG Emission Savings			
• Scenario 1	0.3-0.5	0.5-0.7	$MMtCO_2e$
• Scenario 2	0.5-0.7	0.7-1.0	$MMtCO_2e$
Net Present Value (2006-2020)	TBD	$million	
Cumulative Emissions Reductions (2006-2020)			
• Scenario 1	4.5 to 6.5	$MMtCO_2e$	
• Scenario 2	7.3 to 10.4	$MMtCO_2e$	
Cost-Effectiveness	TBD	$/tCO_2e$	

Data Sources, Methods and Assumptions:

- **Data Sources:**

American Transportation Research Institute, "Idle Reduction Technology: Fleet Preferences Survey," February 2006 for technology costs.

EPA Smartway Transportation Partnership (http://www.epa.gov/otaq/smartway/idlingtechnologies.htm#truck-mobile) for technology costs.

"Analysis of Tehcnology Options to Reduce the Fuel Consumption of Idling Trucks," ANL/ESD-43, Argonne National Laboratory, Transportation Technology R&D Center, June 2000 for information on technology impacts.

Data from EPA's MOBILE6 model were used to estimate the proportion of CO2 emissions attributable to Class 8 trucks.

Data from USDOE/EIA *Annual Energy Outlook 2005* were used to estimate the amount of fuel consumed annually per truck.

- **Quantification Methods:**

The estimated reduction in CO2 emissions from reduced idling was calculated based on estimating the portion of emissions and fuel consumption in the AZ inventory that were attributable to Class 8 diesel trucks, estimating the portion of the total fuel consumption that would be consumed during idling, and applying a targeted reduction of 50 or 80 percent to this amount in 2010 and a reduction of 50 or 100 percent in 2020.

- **Key Assumptions:**

This analysis assumes idle reductions are achieved only by Class 8 diesel truck population; these trucks idle for an average of 6 hours per day; they consume 0.8 to 1.2 gallons of diesel per hour during idling; and that a 50, 80 or 100 percent reduction of diesel idling from these Class 8 trucks is achieved.

Key Uncertainties:

It is unknown whether a 50 percent penetration in reducing idling emissions from the Class 8 vehicles could be realistically achieved. A small additional reduction in idling emissions could be achieved by buses. The distribution of technology that would be selected by these trucks or fleets to reduce their emissions is highly uncertain. This will have a significant impact on the overall cost/cost savings of this measure. The use of these technologies will also cause a slight decrease in the CO2 and fuel consumption reductions achieved. The use of truck stop electrification would increase emissions from electricity generation.

Equipment cost and lifetime will vary by technology employed. The cost value selected was based on survey data performed by American Transportation Research Institute, representing the average of the capital costs the survey respondents would be willing to pay for idle reduction technology. The cost analysis does not take into account the number of vehicles that have already installed idle reduction technologies.

Ancillary Benefits and Costs, if applicable:

Reductions in idling will also reduce emissions of toxics, NOx, and PM. California estimates that 70 percent of toxic risk comes from diesel engines.

Idle emission reductions will reduce fuel consumption, thus leading to a cost benefit from reduced operating costs.

Additional costs are associated with on-board idle reduction technologies, but fuel savings over time typically lead to a net savings.

Providing idling reduction technologies (electrification/portable power units) at mandatory truck stops, such as Port-of-Entries/weigh stations, could prevent idling in other locations throughout the State. Providing central warehousing infrastructure may avoid idling required for refrigeration or other critical needs. However, providing any new infrastructure requires funding.

Feasibility Issues, if applicable:

Status of Group Approval: (Pending or Completed)

Level of Group Support: (Unanimous Consent, Supermajority, Majority, or Minority)

Barriers to consensus (if less than unanimous consent):

TLU-7 Hybrid Promotion and Incentives

In progress

TLU-8 Feebates

Option Category: Not Quantified

Policy Description: Shift the fleet mix to lower-emitting vehicles by giving consumers a rebate on the purchase of low-emission vehicles and charging a fee when consumers purchase a higher emission vehicle. The change in fleet emissions results somewhat from consumer switching, but primarily from manufacturers' technology choices. Emissions savings increase with the number or participating states.

Policy Design: The structure of a feebate system includes a "pivot point" that determines which vehicles are charged a fee and which are given rebates. The fees and rebates can be set at different levels, including a constant fee or rebate per ton of carbon dioxide, or per gallon of fuel consumed per mile driven.

Implementation Method: Implementing a feebate system in Arizona would have more limited results than a multiple-state feebate system would.

Estimated GHG Savings (for quantified actions):

	2010	2020	Units
GHG Emission Savings	not quantified		

Quantification Methods:

Not undertaken

Key Assumptions: n/a

Key Uncertainties:

The Arizona PIRG report, "A Blueprint for Action," presents estimates of GHG reductions from a feebate program.

The policy analysis conducted by CCS found that a feebate program would essentially duplicate a portion of the results of the Light Duty Vehicle GHG emissions standards (TLU - 1). In addition, a feebate program would be less effective than the emission standards.

If both TLU - 1 and TLU - 8 were adopted, then TLU -8, the feebate program, would not result in any additional reductions in greenhouse gas emissions above and beyond those that result from TLU - 1, the light duty vehicle GHG emissions standards.

Ancillary Benefits and Costs, if applicable:

Feasibility Issues, if applicable:

Status of Group Approval: **(**Pending or Completed)

Level of Group Support: (Unanimous Consent, Supermajority, Majority, or Minority)

Barriers to consensus (if less than unanimous consent):

TLU-9 Pay-As-You-Drive Insurance

Option Category: Quantified

Policy Description: Require automobile insurance on collision and liability to be charged on a per-mile basis instead of at a fixed rate. The collision and liability risks associated with driving increase with mileage, and charging drivers for collision and liability insurance on a per-mile basis can account for this risk. The per-mile charges can be adjusted for other risk factors. This policy contributes to GHG emission reduction by reducing total vehicle miles traveled.

Policy Design: Require insurers to use a mileage-based system for 80 percent of collision and liability payments.

Implementation Method: Beginning in 2008, participation in the mileage-based automobile insurance system increases by 20 percent per year until reaching full participation.

Estimated GHG Savings (for quantified actions):

	2010	2020	Units
GHG Emission Savings	n/a	2.8	MMtCO2e

Quantification Methods:

The Arizona (AZ) PIRG conducted an analysis of the potential GHG savings from a Pay-As-You-Drive (PAYD) automobile insurance policy. The strategy for a PAYD policy that AZ PIRG analyzed assumes that insurers are required to offer mileage-based insurance for certain elements of vehicle insurance, including collision and liability. The AZ PIRG assumes the PAYD policy is required, phased in over time, and that all drivers in Arizona are eventually covered.

To calculate GHG savings, the AZ PIRG converted Arizona state average automobile collision and liability insurance expenditures to an average insurance cost per mile (6.4 cents per mile). Assuming insurance consumers pay 80 percent of their collision and liability insurance on a per-mile basis, drivers would be assessed about a 5.1-cent charge per mile. This per-mile insurance charge would reduce vehicle-miles traveled by about 8 percent, and light-duty vehicle carbon dioxide emissions by about 4 percent. (See AZ PIRG, "A Blueprint for Action," pp. 25-26, 54-55)

CCS compared the AZ PIRG model results for estimated reductions in vehicle miles of travel with other studies of PAYD policies, including those produced by the Economic Policy Institute and Resources for the Future (RFF). CCS found that the AZ PIRG estimates were comparable with other estimates, which ranged from 8 percent to 20 percent. As a result, CCS concluded that the AZ PIRG results for estimated reductions in vehicle miles of travel and greenhouse gas emissions reductions fell within the lower range of the comparable estimates.

Key Assumptions:

The main set of assumptions about the PAYD policy that are important to recognize are that the AZ PIRG scenario assumes (1) state regulation of the Arizona automobile insurance industry to require insurance companies to offer PAYD insurance and (2) eventual application of PAYD insurance to the entire fleet of Arizona light duty motor vehicles.

Key Uncertainties:

The specifics of the PAYD insurance programs are to be determined, and the actual effects of PAYD insurance on driver behavior are subject to some significant uncertainty.

Ancillary Benefits and Costs, if applicable:

Feasibility Issues, if applicable:

Status of Group Approval: (Pending or Completed)

Level of Group Support: (Unanimous Consent, Supermajority, Majority, or Minority)

Barriers to consensus (if less than unanimous consent):

TLU-10 Low Rolling Resistance Tires

Option Category: Quantified

Policy Description: Improve the fuel economy of the vehicle fleet by setting energy efficiency standards for replacement tires and requiring that Low-Rolling Resistance (LRR) replacement tires are available to consumers. Manufacturers currently use LRR tires on new vehicles, but they are not readily available to consumers as replacement tires.

Policy Design: Require that replacement light-duty tires have the same average energy efficiency as original tires provided by the manufacturers.

Implementation Method: LRR replacement tires would be on the market beginning in 2008.

Estimated GHG Savings (for quantified actions):

	2010	2020	Units
GHG Emission Savings	n/a	0.8	MMtCO2

Quantification Methods:

The Arizona PIRG report, "A Blueprint for Action," presents estimates for potential carbon dioxide emission reductions from a low-rolling resistance replacement tire program. The AZ PIRG estimate for GHG reductions is 0.7 MMTCO2, and is based on a 3 percent improvement in the fuel economy of vehicles with LRR tires and an average replacement schedule for tires of four, seven, and eleven years. The estimated 3 percent improvement in fuel economy is consistent with the results of a study conducted for the California Energy Commission. AZ PIRG's analysis assumes a state requirement that all replacement tires in the market are LRR tires. (See AZ PIRG, "A Blueprint for Action," pp. 22-23, 54)

The projected emissions reductions calculated by Arizona PIRG are compared with a different base case scenario than the reference case scenario approved by the Arizona CCAG. As a result, the CCS estimate for the emissions reductions from this policy would be higher than 0.7 MMtCO2 estimated by AZ PIRG.

Key Assumptions:

The amount of greenhouse gas emissions reductions from this policy depends upon the rate at which consumers will replace their existing tires with more fuel efficient tires.

Key Uncertainties:

The low rolling resistance fuel efficient tires program is based upon existing off-the-shelf technologies and products that already exist in the consumer marketplace.

Implementation method(s):

Related Policies/Programs in place:

Types(s) of GHG Benefit(s):

Estimated GHG Savings and Costs Per Ton:

- GHG potential in 2010: n/a   in 2020: 0.7 MMtCO2e
- Net Cost per Ton in 2010, 2020: TBD

Data Sources, Methods and Assumptions:

The Arizona PIRG report presents estimates for potential carbon dioxide emission reductions from a low-rolling resistance replacement tire program. The AZ PIRG estimate for GHG reductions is based on a 3 percent improvement in the fuel economy of vehicles with LRR tires and an average replacement schedule for tires of four, seven, and eleven years. The estimated 3 percent improvement in fuel economy is consistent with the results of a study conducted for the California Energy Commission. (See AZ PIRG Report, pp. 22-23)

The projected emissions reductions calculated by Arizona PIRG are compared with a different base case scenario than the reference case scenario approved by the Arizona CCAG. As a result, the CCS estimate for the emissions reductions from this policy would be higher than 0.7 MMtCO2e estimated by AZ PIRG.

The amount of greenhouse gas emissions reductions from this policy depends upon the rate at which consumers will replace their existing tires with more fuel efficient tires.

Key Uncertainties: The low rolling resistance fuel efficient tires program is based upon existing off-the-shelf technologies and products that already exist in the consumer marketplace.

Ancillary Benefits and Costs, if applicable:

Feasibility Issues, if applicable:

Status of Group Approval: **(**Pending or Completed)

Level of Group Support: (Unanimous Consent, Supermajority, Majority, or Minority)

Barriers to consensus (if less than unanimous consent):

TLU-11 Diesel Engine Retrofits

Option Category: Quantified

Policy Description: Reduce GHG black carbon emissions from heavy-duty diesel vehicles, through the use of applying retrofit emission control technologies and/or retiring/repowering engines.

Policy Design: This measure is designed to target black carbon emission reductions from diesel engines.

- **Goal levels:** Implement a statewide heavy-duty diesel vehicle retrofit program targeted at retrofitting or replacing engines from Class 5 through 8 heavy-duty diesel vehicles (those greater than 16,000 lb Gross Vehicle Weight Rating) and diesel buses This program targets vehicles and buses from model years 1990 through 2006. The earliest model year selected for this measure is 1990, based on EPA's assessment that this is the first model year in which emissions after-treatment devices can be reliably applied to the engines. Retrofitting vehicles from the 2000s will give smaller emission reductions than those from the 1990s, but will still provide some benefits. The new HDV emission standards begin with model year 2007, so no additional reductions are expected to be achieved from the 2007 and newer model years.

- **Timing:** Complete retrofits by 2010.
- **Parties:** Industry, ADEQ, truck owners/operators, bus owners/operators

Implementation methods:

Funding mechanisms and or incentives: Propose legislation to partially fund diesel retrofit technology loan grants.

Voluntary and or negotiated agreements: Work with regional diesel collaboratives to find funding sources and/or pilot programs for regulated entities to promote voluntary compliance.

Codes and standards: A statewide mandate would likely be needed to achieve full participation and achieve maximum reductions.

Pilots and demos: Coordinate with product developers to help them promote their technologies. Investigate availability of funds for pilot or demo projects on diesel retrofit technologies from EPA, DOE, and DOT. If funding is available, develop a pilot program to evaluate the effectiveness of various technologies.

Related Policies/Programs in place:

Types(s) of GHG Benefit(s):

Applying retrofit technologies will reduce exhaust black carbon emissions from heavy duty diesel vehicles.

Estimated GHG Savings and Costs Per Ton (for quantified actions):

	2010	2020	Units
GHG Emission Savings	0.13-0.28	0.01-0.01	MMtCO2e

Note that the emission reduction is significantly smaller in 2020 from this measure due to the natural fleet turnover to vehicles meeting the 2007 HDV emission standards. By 2020, there are very few engines of the 1990 through 2006 model years expected to be remaining in the fleet.

Net Present Value (2006-2020) TBD $million

Cumulative Emissions Reductions (2006-2020) 0.8 to 1.6 MMtCO2e

Cost-Effectiveness TBD $/tCO2e

Data Sources, Methods and Assumptions:

- **Data Sources:**

"Diesel Retrofit Technology: An Analysis of the Cost-Effectiveness of Reducing Particulate Matter Emissions from Heavy-Duty Diesel Engines Through Retrofits," EPA420-S-O6-002, US Environmental Protection Agency, Office of Transportation and Air Quality, March 2006.

Data from EPA's MOBILE6.2 model were used to estimate the mix of PM10 emissions from heavy-duty diesel vehicles and buses by model year.

"Final Arizona Greenhouse Gas Inventory and Reference Case Projections 1990-2020," The Center for Climate Strategies, June 2005.

"RIA Local Mobile Measures Methodology," EPA memo on the estimation of potential local control measures, May 2006.

- **Quantification Methods:**

The 2002 PM10 and black carbon emissions estimates prepared for Arizona's greenhouse gas emissions inventory by CCS were used as the baseline emissions. These were scaled by AZ diesel fuel use and fleet average PM10 exhaust emission rates to 2010 and 2020 to estimate 2010 and 2020 statewide PM10 emissions. Data from EPA's MOBILE6.2 emission factor model were used to estimate the mix of vehicles types and ages in the fleet. Reductions from the retrofit and repowering controls were based on EPA's assumptions by model year, with diesel oxidation catalysts (DOCs) assumed to reduce PM emissions by 20 percent, diesel particulate filters by 90 percent, and replacements providing a 90 to 98 percent PM reduction. PM10 exhaust emission reductions were then scaled to black carbon and CO2 equivalent emission reductions.

- **Key Assumptions:**

This analysis assumes all model year 1990 through 2006 diesel vehicles and buses of 16,000 lb GVWR and greater will be retrofit or repowered/replaced by 2010. The mix of technologies by model year is based on EPA's assumptions for the PM RIA and their overall cost per ton of PM10 reduced was applied to the estimated PM10 emission reductions to estimate total costs.

Key Uncertainties:

It is impractical to expect that 100 percent of these vehicles would be retrofitted or replaced. The quantification performed here should be considered the upper bounds of potential reductions from this measure.

Ancillary Benefits and Costs, if applicable:

The diesel retrofit/replacement control measures will also reduce emissions of PM, HC, CO, and NOx from heavy-duty diesel vehicles.

Feasibility Issues, if applicable:

Status of Group Approval: (Pending or Completed)

Level of Group Support: (Unanimous Consent, Supermajority, Majority, or Minority)

Barriers to consensus (if less than unanimous consent):

TLU-12 Biodiesel Implementation

Option Category: Quantified

Policy Description: Increase market penetration of biodiesel fuels in Arizona. (Ethanol reductions are presented under TLU-5.

Policy Design:

In combination with TLU-5 (Standards for Alternative Fuels), develop policies to increase the penetration of biodiesel sold and consumed in Arizona. Through the National Energy Act, growth in alternative fuels is expected in the near term. This measure will help to ensure that Arizona is actively pursuing and meeting or exceeding the alternative fuel penetration goals specified in this Act.

- **Goal levels:**

Scenario A: 75% B2 penetration by 2010; 50% B20 penetration by 2020

Scenario B: 100% B2 penetration by 2010; 100% B20 penetration by 2020

- **Timing:** See above.
- **Parties:** Industry**,** AZDWM, ADOT, ADEQ, local jurisdictions, school districts

Implementation method(s): (provide category from standard CCS list, with details as needed)

Related Policies/Programs in place:

Types(s) of GHG Benefit(s): (indicate which GHGs to be reduced)

This measure will reduce emissions of CO2 by 78 percent when compared to CO2 emissions from diesel fuel.

Estimated GHG Savings and Costs Per Ton (for quantified actions):

	2010	2020	Units
GHG Emission Savings	0.11-0.15	1.08-2.18	MMtCO2e

Net Present Value (2006-2020)	TBD	$million
Cumulative Emissions Reductions (2006-2020)	8.8 to 17.5	MMtCO2e
Cost-Effectiveness	TBD	$/tCO2e

Data Sources, Methods and Assumptions:

- **Data Sources:**

"Final Arizona Greenhouse Gas Inventory and Reference Case Projections 1990-2020," The Center for Climate Strategies, June 2005.

"Documentation of Inputs to Macroeconomic Assessment of the Climate Action Team Report to the Governor and Legislature," California Climate Action Team, January 2006.

- **Quantification Methods:**

The quantity of diesel fuel projected to be used in Arizona in the AZ GHG inventory were multiplied by the penetration rate of biodiesel fuel (0.02*0.75 for the low scenario in 2010, 0.02*1.0 for the high scenario in 2010, 0.20*0.5 for the low scenario in 2020, and 0.20*1.0 for the high scenario in 2020). Emission reductions from this option were quantified based on multiplying the biodiesel fuel penetration by a CO2 emission factor of 1.03*10-8 MMtCO2/gal and then applying a 78% reduction in CO2 to account for the biodiesel CO2 reduction.

- **Key Assumptions:**

This analysis assumes a 78% reduction in CO2 emissions from biodiesel fuel.

Key Uncertainties:

Ancillary Benefits and Costs, if applicable:

The use of biodiesel will also reduce emissions of PM, SO2, CO, and HC. However, biodiesel will increase emissions of NOx (a 2% increase for B20 biodiesel).

Feasibility Issues, if applicable:

Status of Group Approval: (Pending or Completed)

Level of Group Support: (Unanimous Consent, Supermajority, Majority, or Minority)

Barriers to consensus (if less than unanimous consent):

Table 9.

Agriculture and Forestry Technical Work Group

Summary List of Draft Policy Options

#	Policy Name	GHG Savings ($MMtCO_2e$)	Cost Effectiveness ($/$tCO_2e$)
	AGRICULTURE		
A-1b	Manure Management – Land Application	TBD	TBD
A-4	Change Feedstocks (optimize for CH4 and/or N_2O reduction)	2010: 0.03 2020: 0.07	$165
A-6	Grazing Management	TBD	TBD

NOTES:

Document format: This revised format for policy descriptions and results is consistent with forms used at the most recent CCAG meeting, and will be used for (appendices to) the draft final report.

Yellow highlights: These indicate comments or changes to the policy option write-ups since the last CCAG meeting.

Data gaps: Data gaps and uncertainties have been listed within the text for each option.

Policy overlaps: GHG reductions associated with biomass energy utilization from biomass supply quantified from options F3a and F3b will overlap with GHG reductions achieved by commercializing biomass gasification/combined cycle technology in option F4 (since the biomass energy from F3a and b will serve as input to F4). Therefore, GHG reductions have been quantified under F3a and b only.

Table 10.

Description of Draft Agriculture and Forestry Policy Options

A-1b Manure Management – Land Application

Policy Description: Reduce N20 emissions from daily spread and other land application of dairy and feedlot cattle manure through the use of better application methods, such as direct injection of liquid waste. These application methods are designed to reduce contact of manure nitrogen with air (lowering the rate of denitrification) and the amount of manure nitrogen loss via leaching and runoff.

Policy Design:

- **Goal levels:** Program goal of changing manure land application methods for 20% of beef and dairy cattle by 2010 and 50% of beef and dairy cattle by 2020.
- **Timing:** See goal above.
- **Parties:** AZ Department of Agriculture, Arizona Department of Environmental Quality, Agricultural Extension Offices, dairy and feedlot operators.
- **Other:**

Implementation method(s): To be determined.

Related Policies/Programs in place: To be determined.

Types(s) of GHG Benefit(s):

- N2O: Reduces N20 emissions by minimizing manure nitrogen contact with air; or nitrogen losses via leaching or runoff which result in subsequent N20 emissions.

Estimated GHG Savings and Costs Per MMTCO$_2$e (for quantified actions):

- GHG potential in 2010, 2020: Not Quantified (see Data Sources below).
- Net Cost per MMTCO$_2$e in 2010, 2020

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** There are little data available on the reductions of N20 associated with different manure application methods. Most previous studies have focused on reductions in NH3 (ammonia) emissions, increased nitrogen uptake by crops, or lower nitrogen runoff. CCS identified one source of information that suggested that subsurface application of manure could lower nitrogen oxide (NO) emissions, but actually raise N20 emissions.[2]

- **Quantification Methods:** Due to the lack of available data, benefits and costs for this option were not quantified.
- **Key Assumptions:** Not applicable.

Key Uncertainties: See data sources above.

Ancillary Benefits and Costs, if applicable:

- Reduction of ammonia, VOC emissions, and odor.
- Increased in nitrogen utilization by crops and pastures.
- Decreased leaching and runoff of nitrogen to ground and surface water.

Feasibility Issues, if applicable: Data were not identified to assess the technical feasibility of this option (i.e., N20 emission reductions due to better application methods).

Status of Group Approval: Pending – The TWG does not recommend moving forward with this option, until better data are identified.

Level of Group Support: Unanimous Consent

Barriers to consensus (if less than unanimous consent):

A-4 Change Livestock Feedstocks

Policy Description: Reduce methane emissions from beef and dairy cattle by changing (optimizing) livestock feedstocks.

Policy Design:

- **Goal levels:** Change feedstock for 50**%** of dairy and feedlot cattle to a feed regimen that lowers methane emissions.
- **Timing:** 20% of dairy and feedlot cattle on methane lowering diet by 2010, 50% by 2020.
- **Parties:** Beef and dairy producers, industry associations, agricultural extension offices, Arizona Department of Agriculture.
- **Other:**

Implementation method(s): Not determined.

Related Policies/Programs in place: TWG members indicated that a significant portion of Arizona cattle are fed cottonseed as part of their regimen. The incremental benefit of additional edible oil supplementation to lower methane emissions is unknown.

[2] http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/004/Y2780E/y2780e02.htm.

Types(s) of GHG Benefit(s):

- CH4: Addition of edible oils to feedstocks can reduce CH4 emissions from enteric fermentation in cattle. Vegetable oils are more dense digestible energy sources that require less fermentation in the rumen for energy to be released.

Estimated GHG Savings and Costs Per $MtCO_2e$ (for quantified actions):

- GHG potential in 2010, 2020: 0.029 MMtCO2e in 2010, 0.073 MMtCO2e in 2020
- Net Cost per $MtCO_2e$ in 2010, 2020: $244/MtCO2e

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** The populations of dairy and feedlot cattle in Arizona in 2004 were obtained from the USDA[3]. Emission reductions from the addition of edible oil to cattle feedstocks and the amount of oil consumed per head were taken from a study on the effects of various feed additives on enteric fermentation methane emissions[4]. Costs for edible oils were obtained from the USDA[5].
- **Quantification Methods:** Cattle populations were assumed to remain constant from 2004 levels to 2020. Emission savings were estimated by applying the 21% emission reduction to the estimated methane emissions for 20% of the population in 2010 and 50% of the population in 2020. Costs were estimated by multiplying the cost of soybean oil ($0.23 per lb) by the amount consumed by each head of cattle (400 g/head/day or 0.88 lb/head/day).
- **Key Assumptions:** Cattle populations were assumed to remain constant from 2004 levels to 2020. Soybean oil was chosen to estimate costs, because it is less expensive than sunflower oil (the oil used in the emissions study). It was assumed that any edible oil would produce a similar reduction of methane emissions.

Key Uncertainties: As noted above, currently many AZ cattle have cottonseed included as part of their feed. Therefore, it is unclear whether there is a significant incremental benefit achieved by the inclusion of edible oils into the feeding regimen.

Ancillary Benefits and Costs, if applicable: Potential higher value of meat products from cattle fed edible oils.

Feasibility Issues, if applicable: See uncertainties above.

Status of Group Approval: Completed

Level of Group Support: Minority

[3] Arizona Annual Livestock, May, 2004, USDA NASS, http://www.nass.usda.gov/az/lvstk/2004/040525al.pdf
[4] McGinn et al., 2004, “Methane emissions from beef cattle: Effects of monenesin, sunflower oil, enzymes, yeast, and fumaric acid.” http://jas.fass.org/cgi/content/full/82/11/3346
[5] Oil Crops Outlook, Feb, 2006, USDA ERS, http://usda.mannlib.cornell.edu/reports/erssor/field/ocs-bb/2006/ocs06bf.pdf

Barriers to consensus (if less than unanimous consent): Several TWG members did not support moving forward with this option due to the issue noted under key uncertainties above.

A-6 Rotational Grazing/Improve Grazing Crops and/or Management

Policy Description: Increase carbon sequestration in grazing lands through rotational grazing, improvement of grazing crops, and/or grazing management.

Policy Design:

- **Goal levels:** Program goal of bringing **X** acres of poorly managed grazing land under new management practices.
- **Timing:** Acres of grazing land brought under new management practices by 2010, 2020 and 2050.
- **Parties:**
- **Other:**

Implementation method(s): To be determined.

Related Policies/Programs in place: To be determined.

Types(s) of GHG Benefit(s):

- CO2: Carbon savings (sinks) are a result of enhanced sequestration on grazing lands. Sequestration is enhanced by using grazing management techniques that elevate the health status of plants on grassland ecosystems.

Estimated GHG Savings and Costs Per MMTCO$_2$e (for quantified actions):

- GHG potential in 2010, 2020: Not determined due to lack of data.
- Net Cost per MMTCO$_2$e in 2010, 2020: Not determined due to lack of data.

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** The TWG was unable to find sufficient information to assess the benefits and costs of this option. No data were found to identify the grazing lands in AZ, where different management practices could be implemented to increase carbon sequestration. Further, discussions with TWG members and an outside expert did not reveal a significant potential for enhancing soil or above-ground carbon in AZ grazing lands.

  Managing native vegetation on rangelands in Arizona does not represent a reliable sink for sequestering carbon in soils in the near term (10 year period). Low (<10'" average precipitation) and erratic rainfall precludes a consistent sequestration response of sufficient amounts to warrant making this option a high priority compared to other emission reduction and sequestration options. However, the management of rangelands with existing technologies to improve soil and vegetation conditions over longer periods does represent an important strategy for reducing losses of carbon and increasing soil carbon.

- **Quantification Methods:** Not quantified (see data sources above).
- **Key Assumptions:**

Key Uncertainties:

Ancillary Benefits and Costs, if applicable:

- Higher quality grassland habitat for wildlife.

Feasibility Issues, if applicable: Additional research is needed to assess the feasibility of this option in AZ (see Data Sources above).

Status of Group Approval: Completed

Level of Group Support: Minority

Barriers to consensus (if less than unanimous consent): Members of the TWG were not comfortable in moving forward with this option due to the need for additional information to assess its technical feasibility in AZ (i.e., identification of rangelands where changes in management practices could achieve carbon sequestration returns). The potential for significant benefits by 2020 is also low.

Table 11.

Cross Cutting Issues Technical Work Group

Summary List of Pending Policy Options (2 Total)

#	Policy Name	Potential Next Steps
	CROSS CUTTING ISSUES	
CC-1	State Greenhouse Gas Goals	Quantify for TWG review
CC-3	State Greenhouse Gas Registry	Draft recommendation without quantification

Table 12.

Description of Draft Cross Cutting Policy Options

CROSS CUTTING ISSUES

CC-1 State Greenhouse Gas Goals

Option Category: Quantified.

Policy Description:

Statewide GHG emissions reduction goals and or targets for future time periods.

Policy Design:

The CCAG requested exploration of a statewide emissions reduction target that would continue to 2050, extending the scenario that reduces growth in total statewide GHG emission levels starting in 2005 by 25% in 2010 and 50% in 2020. In addition, the CCAG requested inclusion of the common but differentiated goals of Annex 1 countries under the Kyoto Protocol to the UNFCCC.

- **Goal levels:** As noted above.
- **Timing:** As noted above.
- **Parties:** All.
- **Other:**

Implementation method(s):

Related Policies/Programs in place:

Types(s) of GHG Benefit(s):

Estimated GHG Savings and Costs Per Ton:

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:**
- **Quantification Methods:**
- **Key Assumptions:**

Key Uncertainties:

Ancillary Benefits and Costs, if applicable:

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

Barriers to consensus (if less than unanimous consent):

CC-3 State Greenhouse Gas Registry

Option Category: Not Quantified.

Policy Description:

Measurement and recording of GHG emissions reductions at a macro- or micro-scale level in a central repository with a "transaction ledger" capacity to support tracking, management, and "ownership" of emission reductions as well as to encourage GHG reductions, to enable potential recognition, baseline protection, and/or the crediting of actions by implementing programs and parties in relation to possible emissions reduction goals, and to provide a mechanism for regional, multi-state, and cross-border cooperation. Subject to appropriately rigorous quantification, GHG registration should not be constrained to particular sectors, sources, or approaches so as to encourage GHG mitigation activities from all quarters.

Policy Design:

Recommendations for key policy design elements build off the GHG Reporting policy option (CC-2) and are noted in the accompanying "*GHG Registry Design Options Matrix*." Elements include:

- Geographic applicability at least at the statewide level and as broadly (i.e., regionally or nationally) as possible.
- Allowing sources to start as far back chronologically as good data exists, as affirmed by third-party verification, and allowing registration of project-based reductions or "offsets" that are equally rigorously quantified.
- Incorporating adequate safeguards to ensure that reductions aren't double-counted by multiple registry participants; providing appropriate transparency; and allowing the state to be a valid participant for reductions associated with its programs, direct activities, or efforts.
- Striving for maximum consistency with other state, regional, and/or national efforts; greatest flexibility as GHG mitigation approaches evolve; and providing guidance to assist participants.

- **Goal levels:** Not applicable.
- **Timing:** ASAP after GHG reporting is operating.
- **Parties:** Probably overseen by ADEQ; costs shared by participants benefiting from the registry.
- **Other:**

Implementation method(s):

Related Policies/Programs in place:

Types(s) of GHG Benefit(s):

Estimated GHG Savings and Costs Per Ton:

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:**
- **Quantification Methods:**

- **Key Assumptions:**

Key Uncertainties:

Ancillary Benefits and Costs, if applicable:

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

Barriers to consensus (if less than unanimous consent):